Space Weather Technical Forecast

Issued on Saturday, 14 January 2023 at 00:47 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares (R1-R2 radio blackouts) expected. Chance of X-class (R3 radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the last 24 hours, with two M-class flares, the largest of these a M3.9 at 13/1015UTC from AR3181 near the southwest limb. There are currently ten numbered and two un-numbered regions on the visible disc.

AR3181 is gradually disappearing from view at the southwest limb with only the trailer spots visible. AR3182 in the southwest quadrant continues to show decay and may have a very small delta configuration in one of it's northern spots. AR3184, in the southeast quadrant, is showing some slight growth and consolidation in its trailer spots. AR3185 and AR3189 in the northwest are small and unremarkable, with little change. AR3186, in the northeast, is the largest region and appears to be consolidating into lead and trailer portions, with a hint of a very small delta configuration in the trailer. AR3190, AR3191 and AR3192 are still to fully emerge at the southeast and northeast limbs, with foreshortening effects making full analysis difficult.
No new Earth-directed CMEs have been identified on available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 were in the range 360-430km/s, but increased after 13/1800UTC to reach a peak of around 540km/s. Density was average to below average level, but also increased to occasionally above average after 13/1800UTC. Magnetic field strength showed a similar trend, increasing from weak to moderate for a time during the UTC evening of 13th, peak 11nT, before weakening again in the last couple of hours. The north-south component was often negative/southward, becoming occasionally moderate in strength later in the UTC day, peak -10nT. Phi angle was predominantly negative (towards the Sun) throughout but showed brief variations to positive (away from the Sun) in the second half of the UTC day. The above parameters appeared to indicate evidence of passing CME influence. Geomagnetic activity was mainly Quiet (Kp 1-2) but became Unsettled to Active from 13/1800UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 was mostly at background levels, although showed an enhancement through the 13th but below the S1 level, due to a flare/CME event from just beyond the southwestern limb.. High energy electron flux (greater than 2 MeV) was at background to moderate levels, with a peak of 327pfu at 13/1825UTC. The 24-hour integrated electron fluence stayed well below the Active threshold but showed a rising trend, reaching 5.17e6 integrated pfu at 13/2359 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to continue at Moderate levels, with further M-class flares likely and a slight chance of a Strong (X-class) flare.

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Solar Wind / Geomagnetic Activity: Suspected glancing interaction with the 9th Jan CME may linger at first into day 1 (14th). A further CME is possible on 15th or 16th January from an eruption on 11 January, potentially giving some glancing interaction, although with very low confidence.
Otherwise, any high speed stream effects from coronal hole 62 will wane, with no coronal hole high speed streams forecast through the next four days.
Geomagnetic activity is expected to be mainly Quiet to Unsettled over the next 24 hours, with the chance of further isolated Active intervals at first on day 1 (14th), and perhaps again on day 2 (15th), due to possible CME effects. Mainly Quiet conditions currently expected through days 3 and 4 (16th and 17th).
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES-16 is likely to remain at predominantly background with a chance of further enhancements which could produce an S1 or greater event through the period. The high energy electron flux (greater than 2 MeV) is expected to continue at background to moderate levels, with the corresponding electron fluence remaining below the Active (1e8 integrated pfu) threshold.

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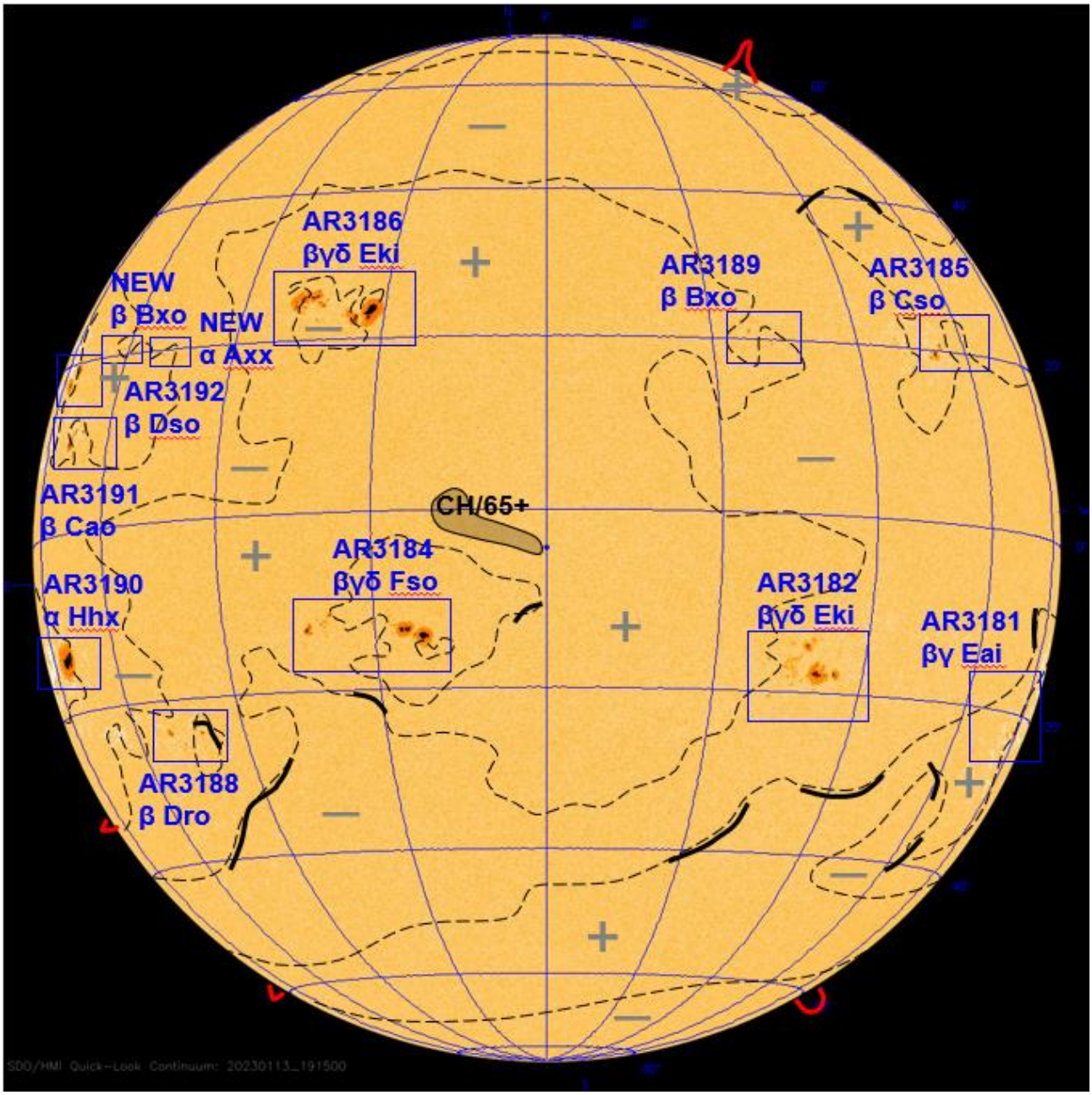
Figure 1. Solar Analysis Valid 13/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar wind speeds increased through the evening (UTC) of 13th reaching 540km/s, along with moderately strong and largely southward pointing magnetic fields, this is suspected to be glancing interaction with the 9th Jan CME. A further CME is possible on 15th or 16th January from an eruption on 11 January, potentially giving some glancing interaction, although with very low confidence.

Otherwise, any high speed stream effects from coronal hole 62 will wane, with no coronal hole high speed streams forecast through the next four days. Coronal hole 65, analysed as a weak feature just east of the meridian, is not expected to have any significant influence in the period. Geomagnetic activity is expected to be mainly Quiet to Unsettled over the next 24 hours, with the chance of further isolated Active intervals at first on day 1 (14th), and perhaps again on day 2 (15th), due to possible CME effects. Mainly Quiet conditions currently expected through days 3 and 4 (16th and 17th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
12/0939	Partial	AR3185	NW quadrant	500-550km/s	15/1200	Glance possible. Low confidence.

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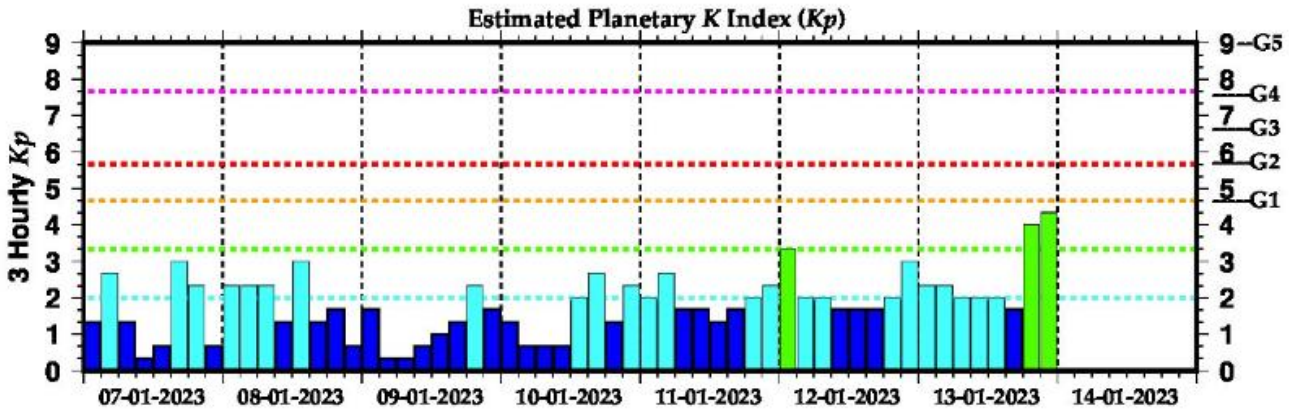
Figure 2: BGS plot of planetary K showing increase during the late 13th.



Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate over the last 24 hours, with two M-class flares, the largest of these a M3.9 at 13/1015UTC from AR3181 near the southwest limb. There are currently ten numbered and two un-numbered regions on the visible disc.

AR3181 is gradually disappearing from view at the southwest limb with only the trailer spots visible. AR3182 in the southwest quadrant continues to show decay and may have a very small delta configuration in one of its northern spots. AR3184, in the southeast quadrant, is showing some slight growth and consolidation in its trailer spots. AR3185 and AR3189 in the northwest are small and unremarkable, with little change. AR3186, in the northeast, is the largest region and appears to be consolidating into lead and trailer portions, with a hint of a very small delta configuration in the trailer. AR3190, AR3191 and AR3192 are still to fully emerge at the southeast and northeast limbs, with foreshortening effects making full analysis difficult.

Solar activity is expected to continue at Moderate levels, with further M-class flares likely and a slight chance of a Strong (X-class) flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	15	15	15	15

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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10 MeV) proton flux observed by GOES-16 showed an enhancement through the 13th but below the S1 level, due to a flare/CME event from just beyond the southwestern limb. There is a chance of further enhancements which could produce an S1 or greater event through the period, initially due to the presence of AR3181 and AR3182 in the western hemisphere, then latterly from the additional contribution of AR3184 and AR3186 as these regions transit westward.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	30	30	30
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to be at background to moderate levels over the next four days in the absence of a strong high speed stream, or any other significant modifying factors to enhance counts within the radiation belts.

Electron fluence values are well below the Active threshold, although with a recent upward trend, and are most likely to remain below through the next four days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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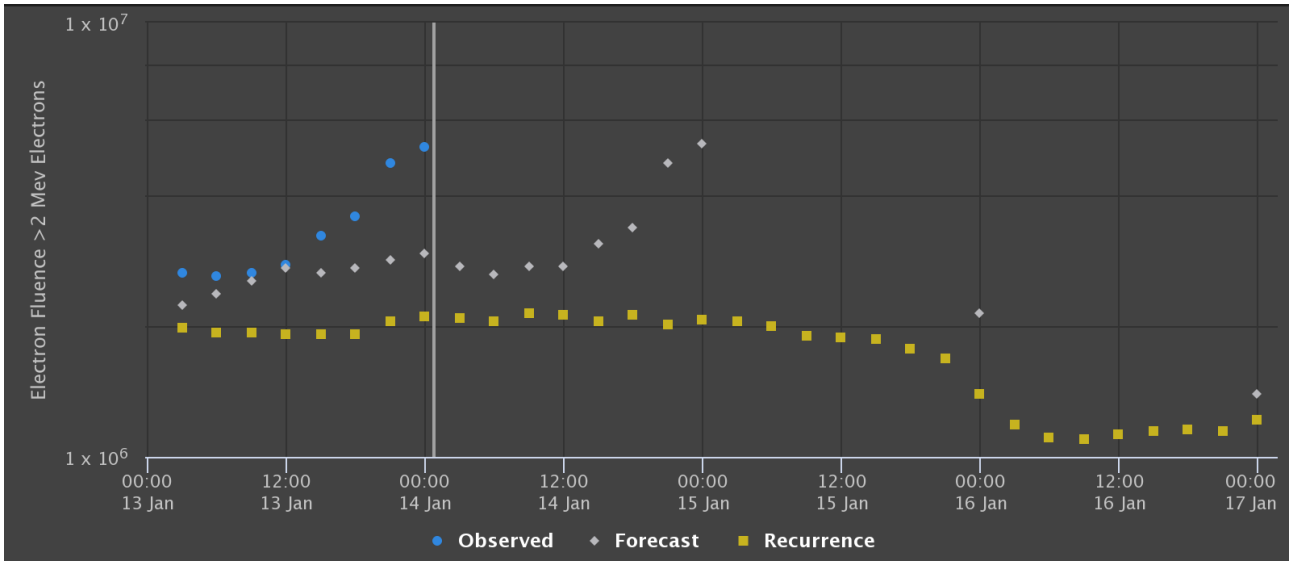
Figure 3: MOSWOC REFM latest output.



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